MULTIMEDIA UNIVERSITY ™

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2022/2023

EEL2046 – ENERGY CONVERSION II

(LE)

03 JULY 2023
9.00 AM – 11.00 AM
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This Question Paper consists of 3 pages including the cover page with 4 Questions only.

2. Answer **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print your answers in the Answer Booklet provided.

Question 1

(a) State the conditions to be satisfied for a DC Shunt Generator to build-up voltage. With a neat sketch explain the voltage build-up process. [10 marks]

(b) A shunt generator machine has armature resistance of 0.18Ω driven at 1400 rev/min. The magnetization characteristic of the shunt generator at 1400 rev/min. is given by Table 1.

Table 1

I_F in (A)	0	1	2	3	4	5	6
Emf in (V)	7	66	131	181	211	231	244

(i) Determine the critical field resistance for self-excitation. [3 marks]
(ii) Calculate the total field circuit resistance if the induced voltage is 236V. [3 marks]
(iii) Calculate the no-load voltage of the generator if the field circuit resistance is adjusted to 40Ω. [3 marks]
(iv) Assuming no armature reaction, determine the load current supplied by the generator if its terminal voltage is 210V and the field resistance is kept at the value computed in part (ii). [6 marks]

Question 2

(a) A Shunt DC Generator delivering output of 100kW at 230V has Armature resistance is 0.05 Ω and Field Resistance is 57.5Ω. It has a total mechanical and core loss of 1.8kW.
(i) Calculate the generator efficiency at full-load. [4 marks]
(ii) If generator speed is 3000 revolutions/minute, determine the torque applied. [4 marks]

(b) A 4-pole DC shunt motor draws a current of 100A from a 220V DC supply. The field resistance is 110Ω. The armature resistance is 0.3 Ω.It runs at a speed of 1000 rpm.
(i) Draw the equivalent circuit. [3Marks]
(ii) Calculate the induced emf in the armature. [3Marks]
(iii) Calculate the armature copper loss and field copper loss. [3Marks]

(c) A 240V shunt motor runs at 850 rpm when the armature current is 70A. The armature circuit resistance is 0.1Ω. Calculate the required resistance to be placed in series with the armature to reduce the speed to 650 rpm when the armature current is then 50A. [8 marks]

Continued...

Question 3

(a) A single phase squirrel cage motor unable to start itself. List down 5 ways a squirrel cage single phase induction motor could start itself. Also draw the motor connection circuit for each method of start.

[10 marks]

(b) A three-phase squirrel cage induction motor has a synchronous speed of 1800 rpm. It draws an input power of 100kW from a three phase supply. The stator copper and iron losses amount to 10kW.The windage and friction losses are equal to 4kW.If the motor runs at 1620rpm, calculate the following:

(i) the active power transmitted to the rotor [2 marks]
(ii) the slip [3 marks]
(iii) the rotor copper loss [2 marks]
(iv) the mechanical power developed [3 marks]
(v) the mechanical power delivered to the load [2 marks]
(vi) the efficiency [3 marks]

Question 4

(a) A 3-phase with 6 pole stator, stepper motor required for one particular application must be capable of stepping in 6° interval, and it must be capable of running at 600 rpm.

(i) How many rotor poles must this motor have? [4 marks]
(ii) How many pulses per second must be applied to the control circuit? [3 marks]

(b) List out FOUR advantages and FOUR disadvantages of Brushless DC Motor applications

[8 marks]

(c) With the aid of circuit diagram draw and explain how a DC motor can be configured or modified to work as a Universal-Motor. Also with the aid of cross section drawing of the universal motor show clearly how the current, flux and direction effected with a AC and DC source. (Note: Use Fleming Rule and Right Hand Thumb Rule to elaborate)

[10 marks]

End of Paper